

**TECHNICAL REVIEW AND EVALUATION  
OF APPLICATION FOR  
AIR QUALITY PERMIT NO. 1000775**

**I. INTRODUCTION**

The Cinder Lake Landfill is owned and operated by the City of Flagstaff, Public Works Department. The facility is located approximately 5 miles south of Flagstaff on Hwy 89 and Landfill Road in Coconino County, Arizona. Cinder Lake Landfill accepts approximately 72000 megagrams of solid waste per year. The majority of this waste accepted is residential and commercial solid waste.

The primary activities of Cinder Lake Landfill are the transportation and deposition of refuse along with the excavation of cover material and soil. A defined area of the landfill is excavated, lined, and prepared to receive waste prior to acceptance of refuse. The deposited waste is spread and compacted in the designated cell with a wheeled compactor. Cell construction will continue as a cut-and-fill operation, and compacted soil will be used for daily, intermediate, and final cover.

The natural decomposition of the waste materials, and to some extent the evaporation of volatile organic compounds (VOCs) in the waste materials, constitute the primary sources of emissions. The landfill gas (LFG) that is emitted from the landfill is fundamentally 50 percent methane (CH<sub>4</sub>) and 50 percent carbon dioxide (CO<sub>2</sub>), with a fraction containing non-methane organic compounds (NMOCs), and hazardous air pollutants (HAPs). Particulate matter (PM) emissions due to traffic on unpaved roads, application of a cover layer of soil, soil stockpiling, cover layer distribution, and wind erosion make up a significant amount of PM<sub>10</sub> pollution.

Leachate is collected from the cell that is receiving refuse and transmitted to an on-site evaporation pond. Leachate is generated by precipitation or other moisture which permeates through the waste material in place and is contained by a subsurface leachate collection and recovery system. The leachate is collected using pumps and eventually directed to an evaporation pond.

**A. Company Information**

Facility Name:	Cinder Lake Landfill
Mailing Address:	211 West Aspen
	Flagstaff, AZ 86001
Facility Address:	US Highway 89 and Landfill Road
	Flagstaff, AZ, 86004

## **B. Attainment Classification**

Cinder Lake Landfill is in an Attainment Area with respect to all the criteria pollutants.

## **II. PROCESS DESCRIPTION**

Cinder Lake Landfill is an active solid waste landfill (SIC 4953) which accepts municipal solid waste, including residential and commercial wastes. Refuse is trucked in and dumped at a designated location. Current practice is to spread the waste in layers, compacting and covering it with a geosynthetic clay liner and a soil layer. The compacted layers compose the landfill building blocks called cells. The buried waste decomposes biologically and chemically to produce solid, liquid, and gaseous products. Over the course of time the gaseous product which consist of methane, carbon dioxide, non-methane organic compounds, and volatile organic compounds, seeps through the landfill waste and permeates to the surface. This results in landfill gases that are regulated and controlled depending on the age, amount of refuse accepted, and design capacity of the landfill. Currently Cinder Lake Landfill is below the allowable emission rate for non-methane organic compounds therefore Cinder Lake Landfill is not subject to the control requirements specified in the 40 CFR 60 Subpart Cc (Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills).

The liquid product that is produced in the landfill is mainly rain runoff that soaks through the landfill and escapes through the outer limits of the landfill. To prevent this from happening a liner and a leachate collection system was installed. The leachate collection system collects the rain runoff, or leachate, and pumps the leachate to a leachate pond. This pond emits an insignificant amount of VOCs and HAPs. The constant transport of waste to and from specific cells along with the compacting and burial of the waste, generates a significant amount of dust and particulate matter that is dispersed in the air. Wind erosion of the soil cover and other areas located on the landfill adds to the dust problem.

## **III. EMISSIONS**

Representative emissions from Cinder Lake Landfill are presented in the following section. These emissions calculations are **not** meant to establish any baseline emissions levels. These emissions figures are **not** meant to be emissions limitations of any form. The emission factors used to calculate the potential to emit are from AP-42 (1/95 ed. & 9/98 ed.)

### **A. PM10 Emissions for Unpaved Roads**

Assumptions

- Residential vehicle weight is .5 tons (63% of trips)
- Residential vehicles number of wheels is 4
- Commercial vehicle weight is 9.5 (37% of trips)
- Commercial vehicle number of wheels is 10
- The average speed travelled on the roads within the landfill is 15 mph.
- 140000 tons/yr waste acceptance rate
- The landfill operates 10 hours/day and 312 days/yr

$$E=[k(s/12)^a(W/3)^b]/[(M/0.2)^c]$$

where,

E=size-specific emissions factor (lbs/VMT)

k=empirical constant from Table 13.2.2-2 in the AP-42

a=empirical constant from Table 13.2.2-2 in the AP-42

b=empirical constant from Table 13.2.2-2 in the AP-42

c=empirical constant from Table 13.2.2-2 in the AP-42

s=surface material silt content (%)

W=mean vehicle weight (tons)

M=surface material moisture content (%)

k=2.6 (from Table 13.2.2-2 in the AP-42)

a=0.8 (from Table 13.2.2-2 in the AP-42)

b=0.4 (from Table 13.2.2-2 in the AP-42)

c=0.3 (from Table 13.2.2-2 in the AP-42)

s=6.4% (value generated from Table 13.2.2-1 in the AP-42 for landfills)

M=12% (source provided this number)

W=?

1. Calculate mean vehicle weight, W

$$W = .37 (9.5 \text{ tons}) + .63 (0.5 \text{ tons})$$

$$W = 1.10 \text{ tons}$$

2. Calculate the size-specific emission factor, E

$$E=[k(s/12)^a(W/3)^b]/[(M/0.2)^c]$$

$$E=[2.6(6.4/12)^{0.8}(1.10/3)^{0.4}]/[(12/0.2)^{0.3}]$$

$$E= 0.15 \text{ lbs/VMT}$$

a. Calculate Vehicle Miles travelled for one truck per day, VMT/vehicle

Assumptions-

- Distance travelled by a vehicle, one way, is .25 miles. This value is provided by the

source.

The total one way distance is = 0.25 miles

Round trip distance is  $2 * 0.25 = 0.5$  per vehicle.

.5 VMT/trip \* 36569 trips = 18284.5 VMT/yr

3. Calculate the PM10 emissions for unpaved roads,

Emissions =  $18284.5 \text{ VMT/yr} * .15 \text{ lbs/VMT} = 2742.675 \text{ lbs/yr}$

Emissions =  $2742.675 \text{ lbs/yr} * 1\text{yr}/3120\text{hrs} = \mathbf{.879 \text{ lbs/hr}}$

Emissions =  $2742.675 \text{ lbs/yr} * 1\text{ton}/2000\text{lbs} = \mathbf{1.37 \text{ tons/yr}}$

#### B. Heavy Construction Operation PM10 Emission

The PM10 emissions from the constant heavy construction operations like bull dozers, motor graders, compactors, and scrapers are calculated using Tables 11.9-1 and 11.9-2 in the AP-42.

##### *Assumptions*

- the Heavy Construction Operations are only related to the placement and removal of cover material.
- the cover placement takes 2 hours per day.
- 620 hours per year
- VMT is .75 mile per day

1. Scraper travel emissions.

$\text{TSP}_{\#30\mu\text{m}} = 2.7 * 10^{-5} (s)^{1.3} (W)^{2.4}$

s = material silt content (%) = 6.4

W = mean vehicle weight (tons) = 100

$\text{TSP}_{\#30\mu\text{m}} = 2.7 * 10^{-5} (6.4)^{1.3} (100)^{2.4} = 19.03 \text{ lbs/VMT}$

PM10 =  $\text{TSP}(.75)$

PM10 =  $(19.03)(.75) = 14.27$

$14.27 \text{ lbs/VMT} * .75 \text{ VMT/day} = 10.70 \text{ lbs/day}$

$10.70 \text{ lbs/day} * 2 \text{ hrs/day} = \mathbf{21.4 \text{ lbs/hr}}$

$21.4 \text{ lbs/hr} * 620 \text{ hr/yr} * 1\text{ton}/2000\text{lbs} = \mathbf{6.634 \text{ tons/yr}}$

2. Scraper Removing Soil

$.058 \text{ lbs PM10/ ton of daily cover} * 46,620 \text{ tons of daily cover/ yr} = 2704 \text{ lbs/yr}$

$2704 \text{ lbs/yr} / 620 \text{ (hrs/yr)} = \mathbf{4.36 \text{ lbs/hr}}$

$2704 \text{ lbs/yr} * 1 \text{ ton}/2000 \text{ lbs} = \mathbf{1.35 \text{ tons/yr}}$

### 3. Scraper Unloading

.04 lbs PM10/ ton of daily cover \* 46,620 tons of daily cover/ yr = 1864.8 lbs/yr

1864.8 lbs/yr /620 (hrs/yr) = **3.00 lbs/hr**

1864.8 lbs/yr \* 1 ton/2000 lbs = **.93 tons/yr**

### 4. Bulldozer/Compacting Emissions

$TSP_{30\mu m} = (5.7(s)^{1.2})/(M^{1.3})$  (lb/ton)

s = material silt content based on the value used in the unpaved road calculations = 6.4%

M= moisture content = 12%

$TSP_{30\mu m} = (5.7(6.4)^{1.2})/(12^{1.3}) = 2.09$  (lbs of PM10/ton of daily cover)

PM10 = TSP(.75)

PM10 = (2.09)(.75) = 1.57 lbs/ton

1.57 (lbs/ton) \* 46620 tons of daily cover / yr = 73193 lbs/yr

73193 lbs/yr \* 1 yr / 620 hr = **118 lbs/hr**

73193 lbs/yr \* 1 ton / 2000 lbs = **36.6 tons/yr**

### C. Non-Methane Organic Compound Emissions

#### Assumptions

- the year-to-year solid waste acceptance rate is unknown therefore the equation from 40 CFR §60.754(a)(ii) will be used.
- the methane generation potential ( $L_0$ ) is equal to 170 cubic meters per megagram.
- the methane generation rate constant (k) is equal to 0.02 for arid climate region.
- the concentration of NMOC ( $C_{NMOC}$ ) is equal to 629.3 ppm as hexane as a result of Tier 2 analysis.
- the average acceptance rate (R) is equal to 72376 Mg/yr, provided by the source.
- the time since closure (c) is equal to 0, since the landfill is not closed.
- the emission from the landfill occur 8760 hrs/yr

$$M_{NMOC} = 2L_0R(e^{-kc} - e^{-kt})(C_{NMOC})(3.6 \times 10^{-9})$$

$M_{NMOC}$  = mass emission rate of Non- Methane Organic Compounds (NMOC), Mg/yr

$L_0$  = methane generation potential, cubic meters per megagram solid waste

R = average annual acceptance rate, megagrams per year

k = methane generation rate constant, year<sup>-1</sup>

t = age of landfill, years

$C_{NMOC}$  = concentration of NMOC, part per million by volume as hexane

c = time since closure, years. For active landfills c=0 and  $e^{-kc}=1$

$$M_{NMOC} = (2)(170)(72376)(e^{-(0.02*0)} - e^{-(0.02*35)})(629.3)(3.6 \times 10^{-9})$$

$$M_{NMOC} = \mathbf{25.8 \text{ Mg/yr}}$$

#### D. Landfill Gases

To estimate the emissions of other Landfill gases that constitute Hazardous Air Pollutants (HAPs) and compounds subject to the National Ambient Air Quality Standards (NAAQS) and Arizona Ambient Air Quality Guidelines (AAAQG) the following equations will be used.

##### Assumptions-

- 55% of the landfill gas is CH<sub>4</sub>
- 45% of the landfill gas is CO<sub>2</sub>
- Temperature of the landfill is 25 degrees C. (AP-42 2.4-6)
- Concentration of each specific compound was taken from a list in the AP-42 Table 2.4-1. The default concentrations include air infiltration correction.
- the mass emission is assumed to be uncontrolled
- VOC molecular weight is assumed to be that of hexane,
- the operating pressure of the landfill is 1 atmosphere
- the landfill emissions occur 8760 hrs/yr

$$Q_{CH_4} = L_0 R (e^{-kc} - e^{-kt})$$

where,

$Q_{CH_4}$  = Methane generation rate at t, m<sup>3</sup>/yr;

$L_0$  = Methane generation potential, m<sup>3</sup>CH<sub>4</sub>/Mg refuse;

R = Average annual refuse acceptance rate during active life, Mg/yr;

k = Methane generation rate constant, yr<sup>-1</sup>;

c = Time since landfill closure, yrs (c=0 for an active landfill);

t = Time since the initial refuse placement, yrs.

$$Q_{CH_4} = (170 \text{ (m}^3\text{CH}_4\text{/Mg refuse)}) * (60000 \text{ (Mg/yr)}) (e^{-((0.02)*(0))} - e^{-((0.02)*(5))})$$

$$Q_{CH_4} = 970658.3 \text{ m}^3\text{/yr}$$

$$Q_p = 1.82 Q_{CH_4} * (C_p / 10^6)$$

where,

$Q_p$  = Emission rate of pollutant P, m<sup>3</sup>/yr;

$Q_{CH_4}$  = methane generation rate, m<sup>3</sup>/yr;

$C_p$  = Concentration of P in landfill gas, ppmv;

1.82 = Multiplication factor (assumes that approximately 55 percent of landfill gas is CH<sub>4</sub> and 45 percent is CO<sub>2</sub>, N<sub>2</sub>, and other constituents).

Listed below are all the HAPs, NAAQS, and AAAQG pollutants that are in the landfill gas and at what rate they are coming out.

<b>Pollutant</b>	<b>Uncontrolled mass emission rate (tons/yr)</b>	<b>Uncontrolled mass emission rate (lbs/hr)</b>	<b>NAAQS</b>	<b>AAQG (July 15, 1992)</b>	<b>HAP 112b of the CAA</b>
1,1,1- Trichloroethane	0.038	0.009		Y	
1,1,2,2- Tetrachloroethane	0.112	0.026		Y	Y
1,1- Dichloroethane	0.140	0.032		Y	
1,1 Dichloroethene	0.012	0.003		Y	
1,2 Dichloroethane	0.024	0.005		Y	
1,2 Dichloropropane	0.012	0.003		Y	
2-Propanol	1.800	0.411		Y	
Acetone	0.245	0.056		Y	
Acrylonitrile	0.202	0.046		Y	Y
Bromodichloro- methane	0.310	0.071		Y	
Carbon disulfide	0.027	0.006		Y	Y
Carbon monoxide	2.300	0.525	Y		
Carbon tetrachloride	0.000	0.000		Y	Y
Carbonyl sulfide	0.018	0.004		Y	Y
Chlorobenzene	0.017	0.004		Y	Y
Chloroform	0.002	0.000		Y	Y
Chloromethane	0.037	0.008		Y	
Dichlorobenzene	0.019	0.004		Y	Y

Dichlorodifluoro-methane	1.140	0.260		Y	
Ethanol	0.750	0.171		Y	
Ethylbenzene	0.290	0.066		Y	Y
Hexane	0.340	0.078		Y	Y
Hydrogen sulfide	0.728	0.166		Y	
Mercury	0.000	0.000		Y	
Methyl ethyl ketone	0.308	0.070		Y	Y
Methyl isobutyl ketone	0.113	0.026		Y	Y
Pentane	0.143	0.033		Y	
t-1,2-dichloroethene	0.166	0.038		Y	
Trichloroethylene	0.223	0.051		Y	Y
Vinyl chloride	0.276	0.063		Y	Y
Xylene	0.773	0.176		Y	Y
Benzene	0.090	0.021		Y	Y
Toluene	2.180	0.498		Y	Y
VOC	<b>0.304</b>	<b>0.069</b>			
Total HAPS	<b>4.990</b>	<b>1.139</b>			

## OVERALL LANDFILL EMISSION

Emission Type	Pollutant	Potential To Emit (lbs/hr)	Potential To Emit (tons/yr)
Unpaved Roads	PM10	.879	1.37



Scraper Travel Emissions	PM10	21.4	6.634
Scraper Unloading Emissions	PM10	3.0	.93
Scraper Removing Soil Emissions	PM10	4.36	1.35
Bulldozing & Compacting	Pm10	118	36.6
Non-Methane Organic Compounds	NMOCs	—	25.8 (Mg/yr)
Landfill Gases	VOCs	.07	.304
	HAPs	4.99	1.139

#### IV. APPLICABLE REGULATIONS VERIFICATION

The Permittee has identified the applicable regulations that apply to each unit in the permit application. Table I summarizes the applicable regulations that apply to each unit.

Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills (40 CFR §60 Subpart Cc) is applicable to the Permittee because they started construction, or modification, before May 30, 1991. Landfills subject to this subpart comply with the 40 CFR §60 Subpart WWW with minor changes in the reporting and recordkeeping requirements. The Emission Guidelines enables the state of Arizona to implement the State Implementation Plan for Municipal Solid Waste Landfill, (A.A.C. R18-2-731).

**TABLE I : Applicable regulations verification**

UNIT	DATE	CONTROLS	REGULATIONS	VERIFICATION
Landfill	NA	None	40 CFR §60, Subpart A  40 CFR §60, Subpart Cc  40 CFR §60, Subpart WWW  40 CFR §82, Subpart F  40 CFR §61, Subpart M  40 CFR §61.154  A.A.C R18-2-731	General Provisions  Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills  Standards of Performance for Municipal Solid Waste Landfills  Recycling and Emissions Reduction; regulations pertaining to use and handling of ozone-depleting substances  National Emission Standard for Asbestos  Standard for active waste disposal sites  Standards of Performance for Existing Municipal Solid Waste Landfills
Truck Loading/Unloading, Haul Roads, Storage Piles	NA	Watering, etc.	R18-2-604  R18-2-605 R18-2-606 R18-2-607 R18-2-610	Open Areas, Dry Washes or Riverbeds Roadways and Streets Material Handling Storage Piles Evaluation of Non-point Source Emissions
Mobile Sources	NA	NA	AAC R18-2-801 AAC R18-2-802 AAC R18-2-804.A	These rules are applicable to mobile sources

Misc. Generators	Misc.	NA	A.A.C. R18-2-719.A A.A.C. R18-2-719.B A.A.C. R18-2-719.C.1 A.A.C. R18-2-719.E A.A.C. R18-2-719.F A.A.C. R18-2-719.H A.A.C. R18-2-719.I A.A.C. R18-2-719.J A.A.C. R18-2-719.K	AAC R18-2-719 is applicable to all stationary rotating machinery
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## V. PERIODIC MONITORING

### *Landfill Gas*

The monitoring requirements for the landfill gas coming out of the landfill are implemented when the Non-Methane Organic Compound mass emission rate of the landfill exceeds 50 Mg/yr.

If the Permittee decides to install, maintain, and operate an **active collection system**, then the Permittee will be required to monitor;

1. The gauge pressure in the gas collection header on a monthly basis;
2. The Nitrogen or oxygen concentration in the landfill gas on a monthly basis; and
3. The temperature of the landfill gas on a monthly basis.

If the Permittee decides to install, maintain, and operate an **enclosed combustor**, then the Permittee will be required to monitor the temperature of the enclosed combustor and the flow to or bypass of the enclosed combustor.

The temperature monitoring device requires:

- a continuous recorder that has a minimum accuracy of  $\pm 1$  percent of the temperature being measured expressed in degrees Celsius or  $\pm 0.5$  EC, whichever is greater.  
(A temperature monitoring device is not required for boilers or process heaters with design heat input capacity greater than 44 megawatts.)

The device that records flow to or bypass of the enclosed combustor shall either;

- record the flow to the control device every 15 minutes; or
- have the bypass line valve secured in the closed position with a car-seal or a lock-and-key

type configuration. A visual inspection of the seal or closure mechanism shall be performed at least once every month to ensure that the valve is maintained in the closed position and that the gas flow is not diverted through the bypass line.

If the Permittee decides to install, maintain, and operate an **open flare**, then the Permittee will be required to monitor the temperature of the open flare and the flow to or bypass of the open flare.

The open flare requires a heat sensing device, such as an ultraviolet beam sensor or thermocouple, at the pilot light or at the flame itself to indicate the continuous presence of a flame.

The device that records flow to or bypass of the flare shall either,

- record the flow to the control device at least every 15 minutes; or
- have the bypass line valve secured in the closed position with a car-seal or a lock-and-key type configuration. A visual inspection of the seal or closure mechanism shall be performed at least once every month to ensure that the valve is maintained in the closed position and that the gas flow is not diverted through the bypass line.

The Permittee will be required to monitor **surface concentrations of methane** according to the instrument specifications. Any closed landfill that has no monitored exceedances of the operational standard in three consecutive quarterly monitoring periods may skip to annual monitoring. Any methane reading of 500 ppm or more above background detected during the annual monitoring returns the frequency for that landfill to quarterly monitoring.

If the Permittee uses a device other than an open flare or an enclosed combustor, then the Permittee shall provide information satisfactory to the Director describing the operation of the control device, the operating parameters that would indicate proper performance, and appropriate monitoring procedures. The Director shall review the information and either approve it, or request that additional information be submitted. The Director may specify additional appropriate monitoring procedures.

If the Permittee seeks to install a collection system that does not meet the specifications for an active collection system or seeks to monitor alternative parameters, then the Permittee shall provide information satisfactory to the Director describing the design and operation of the collection system, the operating parameters that would indicate proper performance, and appropriate monitoring procedures. The Director may specify additional appropriate monitoring procedures.

### *Asbestos*

The Permittee shall monitor the waste that is being accepted for all asbestos-containing waste material. They must also maintain shipment records of all asbestos containing materials that enter the landfill.

### *Ozone Depleting Materials*

The Permittee shall monitor the amount of Ozone depleting material that enters the landfill area and dispose of it in the proper manner specified in Attachment B of the permit.

### *Non-point Sources*

Non-point Sources include loading/unloading, storage, and haul road traffic activities. Typical controls for these sources of fugitive emissions are wetting material, and paving/wetting roads respectively. The applicable requirement for these activities is A.A.C.R18-2-610. This regulation prescribes a 40% opacity limit on visible emissions from non-point source activity. Each of the activities mentioned above is performed continuously, and results in large emissions of particulate matter. The monitoring plan requires the Permittee to conduct a visual survey of visible emissions from non-point sources biweekly. The visual survey should be performed in accordance with a pre-approved visual observation plan. The visual observation plan should identify a central point, or multiple points from which observations will be taken. The Permittee is required to keep records of the date and results of each survey. Any observed excess emission event will be reported immediately to the Director in accordance with the excess emissions provisions listed in Section XI, Attachment A. Also the Permittee shall ensure that the water trucks are operated daily to control fugitive emissions from haul roads. If the water trucks are not used on a particular day, the Permittee is required to make a record of the date, along with the reason for not using the water trucks.

## **VI. TESTING REQUIREMENTS**

### **Control Efficiency of Collection System**

Testing is required to establish the control efficiency of the collection system. The reduction efficiency or ppmv shall be established by an initial performance test required under 40 CFR §60.8. Method 25C or Method 18 specified in appendix A of the 40 CFR §60 or alternative method approved by the Director shall be used to determine compliance with the 98 weight-percent efficiency or the 20 ppmv outlet concentration level. If using Method 18 of appendix A in the 40 CFR §60, the minimum list of compounds to be tested shall be those published in the most recent Compilation of Air Pollutant Emission Factors (AP-42).

The collection system must be operated so that the methane concentration is less than 500 ppm above the background at the surface of the landfill. To determine if this level is exceeded, the Permittee shall conduct surface testing around the perimeter of the collection area along a pattern that traverses the landfill at thirty meter intervals and where visual observations indicate elevated concentrations of landfill gas, such as distressed vegetation and cracks or seeps in the cover. The Permittee may establish an alternative traversing pattern that ensures equivalent coverage. Areas with steep slopes or other dangerous areas may be excluded from the surface testing.

### **Removal of the Collection System**

After the installation of a collection and control system, the Permittee shall calculate the NMOC emissions rate for the purposes of determining when the system can be removed. The calculated NMOC gas produced by the landfill shall be less than 50 Mg/yr on three successive test dates. The test dates shall be no less than 90 days apart, and no more than 180 days apart. The flow rate of the landfill gas and average NMOC concentration shall be tested on each of the test dates in order to calculate the NMOC mass emission rate.

## **VII. INSIGNIFICANT ACTIVITIES**

<b>No.</b>	<b>POTENTIAL EMISSION POINTS CLASSIFIED AS “INSIGNIFICANT ACTIVITIES” PURSUANT TO A.A.C. R18-2-101.54</b>
1	Tug grinder
2	3200 gallon storage tank
3	Evaporation pond